

# A revision of the genus *Neonaphorura* Bagnall, 1935

(Collembola, Onychiuridae, Tullbergiinae)\*

By J. I. Arbea

Arbea, J. I. (1991): A revision of the genus *Neonaphorura* Bagnall, 1935 (Collembola, Onychiuridae, Tullbergiinae). – *Spixiana* 14/2: 175–188

The genus *Neonaphorura* Bagnall, 1935 is redefined. The diagnosis is modified with addition of new characters. Redescription of European species and description of two new subspecies, *Neonaphorura dubosqi ariegica*, subsp. nov. and *Neonaphorura novempina navarrensis*, subsp. nov., are given. A key of these species is included.

J. I. Arbea, Department of Zoology, University of Navarra E-31080 Pamplona, Spain

## Introduction

Denis (1932) described a species, *Tullbergia dubosqi*, on the basis of a specimen from Banyuls (France). Bagnall (1935) created a new genus, *Neonaphorura*, for *Tullbergia dubosqi*. This genus is characterized by “anal segment with a basal pair of spine-like papillae in addition to four well-chitinized AH, making six processes in all. PAO broad, comprising only twelve triangulate unilocular vesicles. Pseudocelli with broad thickened semicircular rim partly enclosing filaments forming a grate-like structure”.

Wray (1958) described *Tullbergia howdeni* on the basis of specimens from North America, and he created a new subgenus, *Bachatullbergia*. Salmon (1964) established that *Bachatullbergia* is synonymous of *Neonaphorura*: “The only difference between the two being in the arrangement of the smaller spines in the anterior row in *Bachatullbergia* which are close together, while in *Neonaphorura* they are widely spaced. The sense organs of Ant. III are almost identical in both. The PAO vesicles are of similar form but are more numerous in *Bachatullbergia* than in *Neonaphorura*. Such small differences are not, in my opinion, of generic rank”. However, the two genera differ in the shape of vesicles on the postantennal organ. In *Bachatullbergia*, the vesicles are simple. On the other hand, the postantennal organ of *Neonaphorura* is composed of compound vesicles. Therefore, *T. howdeni* does not fit into the genus *Neonaphorura*.

In the present paper, I am going to deal with taxonomic arrangement of the European members of *Neonaphorura*. A close examination reveals that it comprises four species and two subspecies. Two of them, *N. dubosqi ariegica*, subsp. nov. and *N. novempina navarrensis*, subsp. nov., are new to science as it will be described in the following lines.

\* This work was carried out as a part of the Research Project “Fauna Ibérica I” (PB 87–0397), granted by the CICYT.

## Diagnosis

Tullbergiinae with 6–9 anal spines in all; two true distal spines inserted on cuticular papillae, and 4–7 spine-like processes: lateral processes (1+1 or 2+2), dorsomedial processes (0 or 2), an unpaired ventromedial process is present in *N. novemspina* Gisin, 1963, but it is missing in all the others (Fig. 7B–E).

Antennal segments I and II with 7 and 11 setae. Antennal sense organ III with two tiny solenidia (sense rods) between three stout solenidia (two sense clubs and one lateral club), three cuticular papillae and four guard setae; a thick solenidion is present on the ventral side of the antennal segment III. Antennal segment IV with a small apical vesicle entire, five thickened solenidia (*a–e*), and two small solenidia (*f–g*). One additional solenidion *e'* is often differentiated, it is not sometimes thicker than the surrounding hairs (Figs 2B, 3B, 4B, 5B, 6B).

Postantennal organ with two rows of compound vesicles (Figs 3F–G, 4E–F). Tibiotarsi I, II, III with 11, 11, 11 setae, 3, 3, 3 of which are knobbed ventral setae. Claw without inner tooth. Unguiculus absent. Chaetotaxy of the legs is given in the following formula.

	I	II	II
Precoxa 1	2	3	3
Precoxa 2	–	4	4
Coxa	3	7	7
Trochanter	5	5	4
Femur	9	9	9
Tibiotarsus	11	11	11 (3 of which are knobbed)
Pretarsus	2	2	2

Pseudocelli with broad thickened semicircular rim enclosing 3–4 blunt transverse ridges, distributed as it follows: 1, 1/1, 1–2, 1–2/1–2, 1–2, 1–2, 1–2, 1. The lateral pseudocellus on each side of the thoracic segment II to the abdominal segment IV is often weak (Figs 2C–D, 3C–D, 4C–D, 5C–D, 6C–D).

Ventral tube with four setae on each side. Both furca and tenaculum absent. Furcal rest reduced to four short setae.

The cephalic chaetotaxy follows the pattern described for *Dinaphorura* (Najt & Rubio, 1978). Frontal setae: *d1–d5* + *a0* (*d3* setae moved laterally). Subfrontal setae: *sd1*, *sd3–sd5* (*sd2* setae absent; *sd5* setae are macrochaetae). Ocular setae: *oc1–oc3* (*oc2* setae are macrochaetae). Vertical setae: *v1* (*v2* setae absent). Cervical setae: *c2*, *c3*, *c5*. Parietal setae: *p1–p5* (both *p2* and *p5* setae are macrochaetae; *p4* setae are tiny microchaetae). Lateral setae: *g1–g5* (*g5* setae are macrochaetae) (Fig. 1).

Maximum body chaetotaxy is given in Table I. The number and relative length of some setae are important diagnostic characters. Abdominal tergite IV may carry 6 or 10 median setae (both *m3* and *m5* are absent in *N. dubosqi ariegica*, subspec. nov., but present in the remaining species). In the posterior row, *p4a* setae are absent in *N. adulta*, but present in all the others (Figs 2A, 3A, 4A, 5A, 6A, 7A). Abdominal sternite II with 6, 7 or 9 anterior setae (*a0* or *a2* or both sometimes present). Abdominal sternite III with 7 or 9 anterior setae (*a2* sometimes present). Abdominal sternite IV with 6, 8 or 9 anterior setae (*a0* sometimes present; *a2* often present). In the medial row, *m1* setae are present in *N. novemspina*. In the posterior row, *p3* setae are absent in *N. novemspina*, but present in all the others (Figs 1, 3E, 6E).

Type species. *Tullbergia dubosqi* Denis, 1932, by original designation (Bagnall, 1935).

Type locality, Banyuls, Vallée de la Bayorie (France).

Table I. Maximum chaetotaxy of *Neonaphorura* Bagnall, 1935

Segment	Row	DORSAL		VENTRAL	
		Number	Setae	Number	Setae
Th. I	<i>m</i>	8	<i>m1, 2, 3, 4</i>	—	
Th. II–III	<i>a</i>	10	<i>a1, 2, 3, 4, 5</i>	2	<i>a1</i>
	<i>m</i>	8+4	<i>m1, 3, 4, 5+s+ms</i> (*)	—	
	<i>p</i>	8	<i>p1, 3, 4, 5</i>	—	
Abd. I	<i>a</i>	10	<i>a1, 2, 3, 4, 5</i>	—	V. T.: 4+4 (**)
	<i>m</i>	4	<i>m5, 6</i>	4	<i>m1, 2</i>
	<i>p</i>	12	<i>p1, 2, 3, 4, 5, 6</i>	—	
Abd. II	<i>a</i>	12	<i>a1, 2, 3, 4, 5, 6</i>	9	<i>a1, 2, 3, 4+a0</i>
	<i>m</i>	8	<i>m3, 4, 5, 6</i>	3	<i>m2+m0</i>
	<i>p</i>	12	<i>p1, 2, 3, 4, 5, 6</i>	8	<i>p1, 2, 3, 4</i>
Abd. III	<i>a</i>	12	<i>a1, 2, 3, 4, 5, 6</i>	9	<i>a1, 2, 3, 4+a0</i>
	<i>m</i>	8	<i>m3, 4, 5, 6</i>	4	<i>m1, 2</i>
	<i>p</i>	12	<i>p1, 2, 3, 4, 5, 6</i>	8	<i>p1, 2, 3, 4</i>
Abd. IV	<i>a</i>	12	<i>a1, 2, 3, 4, 5, 6</i>	9	<i>a1, 2, 3, 4+a0</i>
	<i>m</i>	10	<i>m2, 3, 4, 5, 6</i>	8	<i>m1, 2, 3, 4</i>
	<i>p</i>	14	<i>p1, 2, 3, 4, 4a, 5, 6</i>	8	<i>p1, 2, 3, 4</i>
Abd. V	<i>a</i>	10	<i>a1, 2, 3, 4, 5</i>	8	<i>a1, 2, 3, 4</i>
	<i>m</i>	6	<i>m3, 4, 5</i>	—	
	<i>p</i>	8	<i>p2, 3, 4, 5</i>	2	<i>p2</i>

(\*) *s*: lateral sensilla; *ms*: lateral microsensilla

(\*\*) V. T.: Ventral Tube

### *Neonaphorura duboscqi duboscqi* Denis, 1932

Figs 1, 7C

Material examined. Vallvidriera, Barcelona (Spain), Selga leg., 2 ♀♀. Barcelona (Spain), Selga leg., 3 ♀♀ (coll. National Museum of Natural Sciences, Madrid, Spain).

#### Redescription

Length 0.85–1.0 mm. White. Antennal segments I, II, III with 7, 11, 19 setae. Antennal sense organ III complete (five dorsal solenidia and one ventral solenidion). Antennal segment IV with six thickened solenidia (*a-e + e'*) (Fig. 2B). Postantennal organ with 10–12 compound vesicles. Tibiotarsi with 11 setae, three of which are long, knobbed ventral setae. Claw without inner tooth. Unguiculus absent. Ventral tube with 4+4 setae. Formula of pseudocelli: 11/122/22211. The lateral pseudocelli on the thoracic segment II to the abdominal segment III may be weak (Figs 2C–D). Abdominal segment VI with six anal spines in all; two true distal spines inserted on cuticular papillae, and 2+2 lateral spine-like processes (Fig. 7C). Chaetotaxy of the body is showed in Table II and Fig. 1. Length ratio of *m2* : *m3* : *m4* : *m5* : *m6* : *p5* on the abdominal tergite IV as follows, 10 : 9 : 68 : 19.5 : 44 : 51.5 (Fig. 2A).

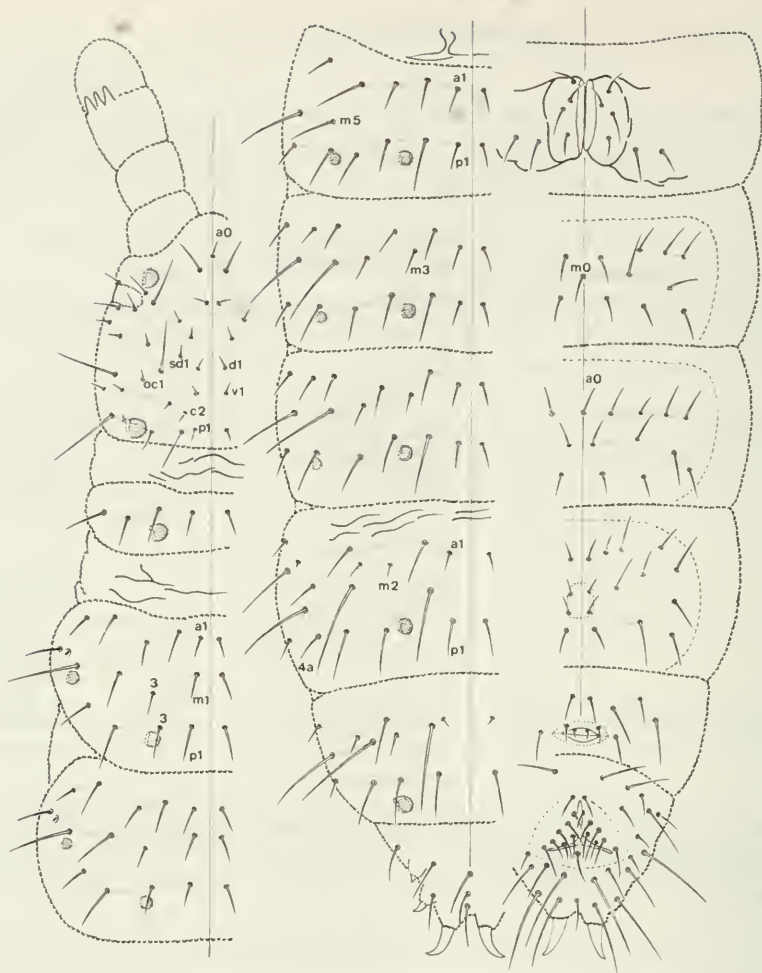


Fig. 1. *Neonaphorura duboscqi duboscqi*. Dorsal and ventral chaetotaxy.

Chaetal variability. Symmetrical (1 subadult ♀) or asymmetrical (2 ♀♀) lack of seta *p4a* on the abdominal tergite IV; symmetrical lack of setae *m5* on the abdominal tergite IV (1 ♀); asymmetrical lack of seta *a2* on the abdominal sternites II and III (2 ♀♀).

Table II. Chaetotaxy of *Neonaphorura duboscqi duboscqi* Denis, 1932

DORSAL CHAETOTAXY							
Row	Th. I	Th. II-III	Abd. I	Abd. II	Abd. III	Abd. IV	Abd. V
a	—	10	10	12	12	10	10
m	8	8 (1)	4	8	8	10	6
p	—	8	12	12	12	14	8
Absent setae						<i>a3</i>	

VENTRAL CHAETOTAXY

a	—	2	—	8	9	8	8
m	—	—	4	3	4	6	—
p	—	—	—	8	8	8	2

Absent setae *a/0* *a0*  
 setae *m1*

(1) + 2 lateral sensillae + 2 lateral microsensillae

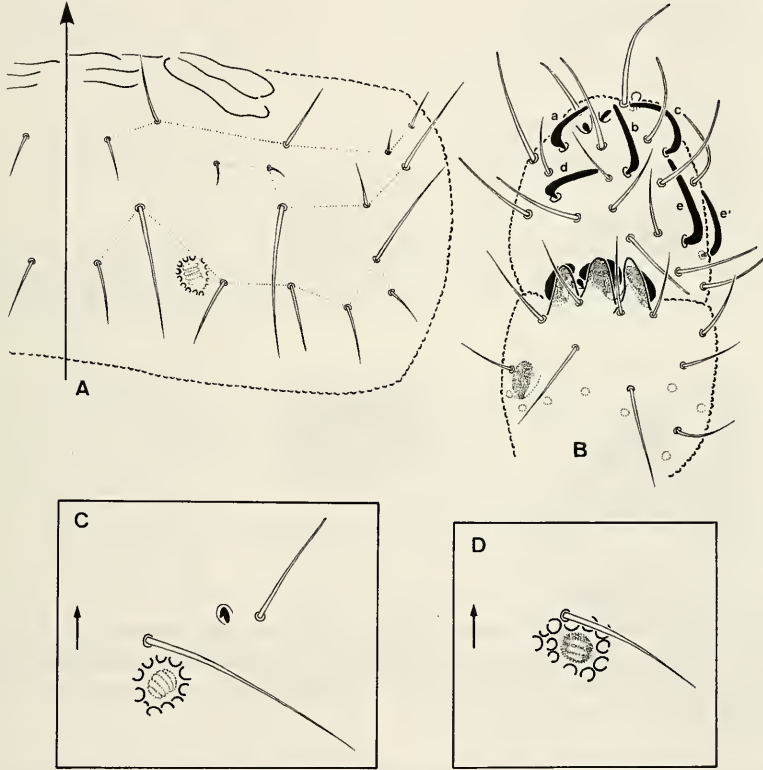


Fig. 2. *Neonaphorura duboscqi duboscqi*. A Chaetotaxy of the abdominal tergite IV. B. Antennal segments III-IV. C. Lateral pseudocellus on the thoracic tergite III. D. Lateral pseudocellus on the abdominal tergite III.

*Neonaphorura duboscqi ariegica*, subsp. nov.

Figs 3, 7C

Type material. Grotte de Durban, Ariège (France), 15. VIII. 1978, Deharveng leg. (09-191 sample), holotype ♀ (coll Louis Deharveng, Univ. Paul Sabatier, Toulouse).

Description

Length 1.21 mm. White. Antennal segments I, II, III with 7, 11, 19 setae. Antennal sense organ III complete (five dorsal solenidia and one ventral solenidion). Antennal segment IV with five thickened

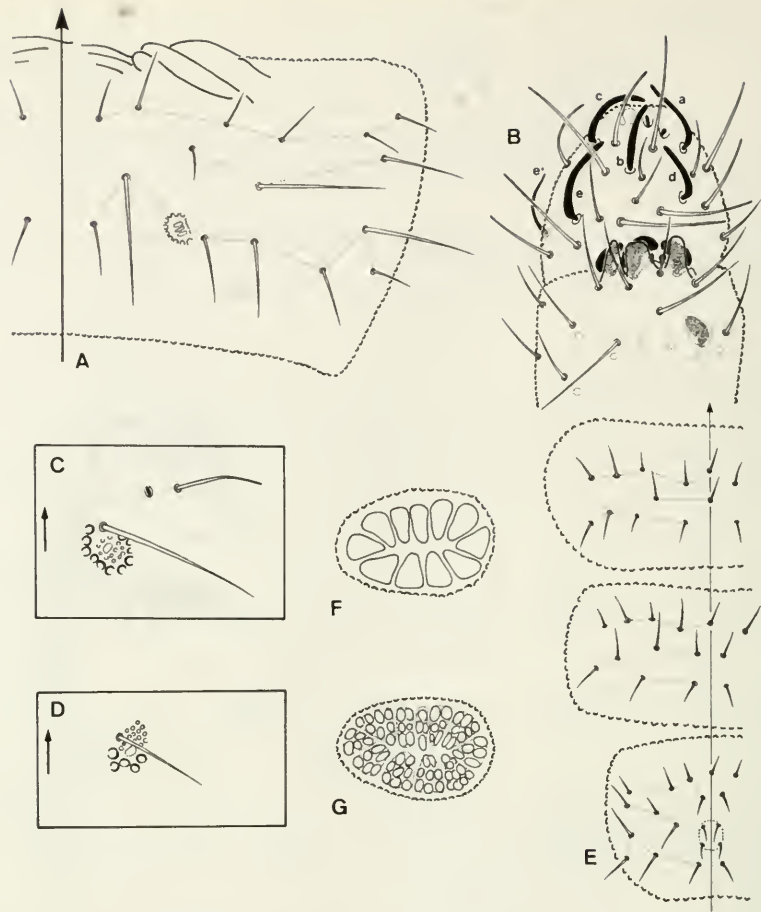


Fig. 3. *Neonaphorura dubosqi ariegica*, subsp. nov. A. Chaetotaxy of the abdominal tergite IV. B. Antennal segments III–IV. C. Lateral pseudocellus on the thoracic tergite III. D. Lateral pseudocellus on the abdominal tergite III. E. Chaetotaxy of the abdominal sternites II–IV. F. Postantennal organ, internal view. G. Postantennal organ, external view.

solenidia ( $a-e$ ). The additional solenidion  $e'$  is not thicker than the surrounding hairs (Fig. 3 B). Postantennal organ with 11 compound vesicles (Fig. 3 F–G). Tibiotarsi with 11 setae, three of which are long, knobbed ventral setae. Claw without inner tooth. Unguiculus absent. Ventral tube with 4+4 setae. Formula of pseudocelli: 11/122/22211. The lateral pseudocelli on the thoracic segment II to the abdominal segment III are weak (Fig. 3 C–D). Abdominal segment VI with six anal spines in all; two true distal spines inserted on cuticular papillae, and 2+2 lateral spine-like processes (Fig. 7 C). Chaetotaxy of the body is showed in Table III. Length ratio of  $m_2 : m_4 : m_6 : p_5$  on the abdominal tergite IV as it follows, 10 : 40 : 24 : 33.5 (Fig. 3 A).

Affinities. This new subspecies is quite similar to the nominate form, *N. dubosqi dubosqi*, except for the absence of dorsal setae  $m_3$  and  $m_5$  on the abdominal tergite IV, and for the presence of an unpaired ventral seta  $a_0$  on the abdominal sternites II and IV. In addition, the only specimen known of *N. dubosqi ariegica*, subsp. nov. is longer than all specimens of the nominated form, and has a thin solenidion  $e'$  on antennal segment IV (thickened in *N. dubosqi dubosqi*).

Table III. Chaetotaxy of *Neonaphorura duboscqi ariegica*, subsp. nov.

DORSAL CHAETOTAXY

Row	Th. I	Th. II–III	Abd. I	Abd. II	Abd. III	Abd. IV	Abd. V
a	—	10	10	12	12	12 (2)	10
m	8	8 (1)	4	8	8	6	6
p	—	8	12	12	12	14	8
Absent setae						<i>m3</i>	
						<i>m5</i>	

VENTRAL CHAETOTAXY

a	—	2	—	9	9	8	8
m	—	—	4	3	4	6	—
p	—	—	—	8	8	8	2
Absent setae						<i>m1</i>	

- (1) + 2 lateral sensillae + 2 lateral microsensillae  
 (2) asymmetrical lack of setae *a3* in the only specimen known

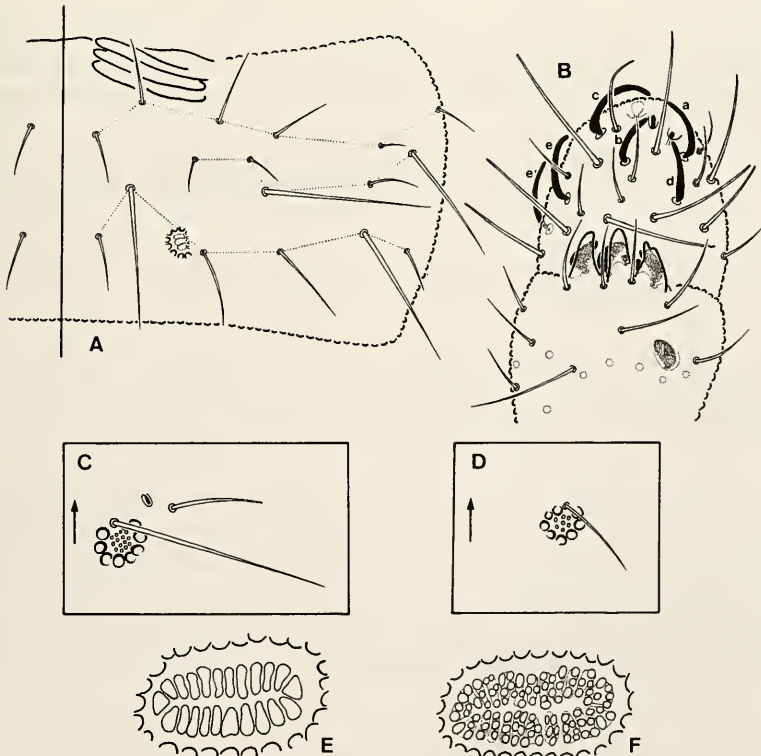


Fig. 4. *Neonaphorura duboscqi ariegica* adult. A. Chaetotaxy of the abdominal tergite IV. B. Antennal segments III–IV. C. Lateral pseudocellus on the thoracic tergite III. D. Lateral pseudocellus on the abdominal tergite III. E. Postantennal organ, internal view. F. Postantennal organ, external view.

*Neonaphorura adulta* (Gisin, 1944)

Figs 4, 7D

Material examined. Hermitage Plain (Eremitagesletten), Jaegersborg Park (Dyrehave) (Denmark), 18.V. 1953, Haarlov leg. (Haarlov, 1960), 3 ♀♀ und 1 immature specimen (ex coll. N. Haarlov deposited at Zoological Museum, University of Copenhagen).

Redescription

Length 1.26–1.35 mm. White. Antennal segments I, II, III with 7, 11, 19 setae. Antennal sense organ III complete (five dorsal solenidia and one ventral solenidion). Antennal segment IV with six thickened solenidia ( $a-e + e'$ ) (Fig. 4B). Postantennal organ with 19–23 compound vesicles (Fig. 4E–F). Tibiotarsi with 11 setae, three of which are long, knobbed ventral setae. Claw without inner tooth. Unguiculus absent. Ventral tube with 4+4 setae. Formula of pseudocelli: 11/122/22211. The lateral pseudocelli on the thoracic segment II to the abdominal segment III often weak (Fig. 4C–D). Abdominal segment VI with eight anal spines in all; two true distal spines inserted on cuticular papillae, and six spine-like processes (two dorsomedial processes and 2+2 lateral processes) (Fig. 7D). Chaetotaxy of the body is showed in Table IV. Length ratio of  $m2 : m3 : m4 : m5 : m6 : p5$  on the abdominal tergite IV as it follows, 10 : 10 : 48.5 : 17.5 : 39 : 44.5 (Fig. 4A).

Chaetal variability. Asymmetrical lack of seta  $p5$  on the thoracic tergites II and III in all adult specimens examined (3 ♀♀); asymmetrical lack of setae  $a2$  (1 ♀), setae  $a4$  (1 ♀), setae  $a5$  (1 ♀) and setae  $m5$  (2 ♀♀) on the abdominal tergite IV; asymmetrical lack of setae  $a3$  on the abdominal sternites II and III (2 ♀♀).

Table IV. Chaetotaxy of *Neonaphorura adulta* (Gisin, 1944)

DORSAL CHAETOTAXY							
Row	Th. I	Th. II–III	Abd. I	Abd. II	Abd. III	Abd. IV	Abd. V
a	–	10	10	12	12	12	10
m	8	8 (1)	4	8	8	8	6
p	–	6–8 (2)	12	12	12	12	8
Absent setae						$m5$ $p4a$	
VENTRAL CHAETOTAXY							
a	–	2	–	6	7	8	8
m	–	–	4	3	4	6	–
p	–	–	–	8	8	8	2
Absent setae				$a0$ $a2$	$a2$	$a0$ $m1$	

(1) + 2 lateral sensillae + 2 lateral microsensillae

(2) asymmetrical lack of seta  $p5$  on the thoracic tergites II–III



*Neonaphorura novempina novempina*, Gisin, 1963

Figs 5, 7E

Material examined. Iron Gate, Djerdap Area (Yugoslavia), *Carpineto orientalis-Quercetum mixtum*, 30.VIII.1975, Bogojević leg. (Bogojević, 1980), 1 ♀ (coll. J. Bogojević, Belgrade University, Yugoslavia).

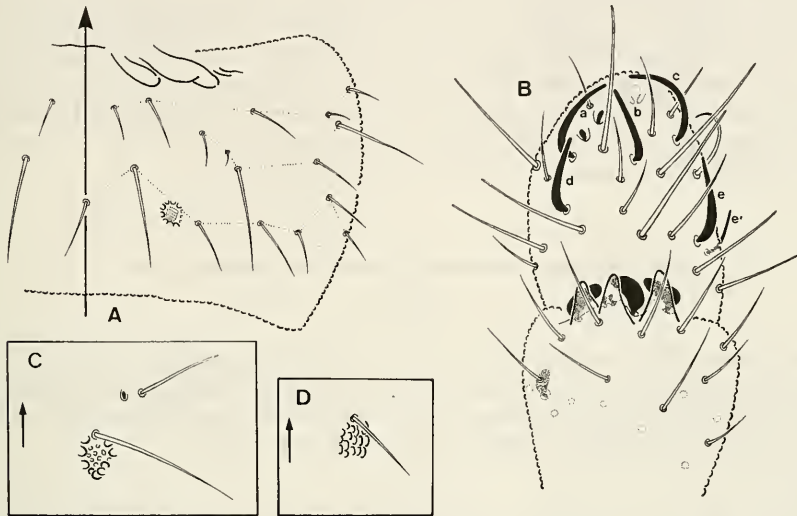


Fig. 5. *Neonaphorura novempina novempina*. A Chaetotaxy of the abdominal tergite IV. B Antennal segments III–IV. C. Lateral pseudocellus on the thoracic tergite III. D. “Lateral pseudocellus” area on the abdominal tergite III.

Table V. Chaetotaxy of *Neonaphorura novempina novempina* Gisin, 1963

DORSAL CHAETOTAXY							
Row	Th. I	Th. II–III	Abd. I	Abd. II	Abd. III	Abd. IV	Abd. V
a	—	10	10	12	12	10	10
m	8	8 (1)	4	8	8	10	6
p	—	8	12	12	12	14 (2)	8
Absent setae						<i>a</i> <sup>3</sup>	
VENTRAL CHAETOTAXY							
a	—	2	—	6	7	6	8
m	—	—	4	3	4	8	—
p	—	—	—	8	8	6	2
Absent setae				<i>a</i> <sup>0</sup> <i>a</i> <sup>2</sup>	<i>a</i> <sup>2</sup>	<i>a</i> <sup>0</sup> <i>m</i> <sup>1</sup> <i>p</i> <sup>4</sup>	

(1) + 2 lateral sensillae + 2 lateral microsensillae

(2) An unpaired dorsomedial seta *a*<sup>1</sup> in the only specimen examined

## Redescription

Length 1.03 mm. White. Antennal segments I, II, III with 7, 11, 19 setae. Antennal sense organ III complete (five dorsal solenidia and one ventral solenidion). Antennal segment IV with five thickened solenidia (*a-e*). The additional solenidion *e'* is not thicker than the surrounding hairs (Fig. 5 B). Post-antennal organ with 11 compound vesicles. Tibiotarsi with 11 setae, three of which are long, knobbed ventral setae. Claw without inner tooth. Unguiculus absent. Ventral tube with 4+4 setae. Formula of pseudocelli: 1, 1/1, 1-2, 1-2/1-2, 1-2, 1-2, 1, 1. The lateral pseudocelli on the thoracic segment II to the abdominal segment III often weak or absent (Fig. 5 C-D). Abdominal segment VI with nine anal spines in all; two true distal spines inserted on cuticular papillae, and seven spine-like processes (2+2 lateral processes, two dorsomedial processes, and an unpaired ventromedial process) (Fig. 7 E). Chaetotaxy of the body is represented in Table V. Length ratio of *m2* : *m3* : *m4* : *m5* : *m6* : *p5* on the abdominal tergite IV as it follows, 10 : 4 : 28 : 13.5 : 26 : 14 (Fig. 5 A).

### *Neonaphorura novemspina navarrensis*, subsp. nov.

Figs 6, 7 E

Type material. Olaberri, Valle de Lónguida (Navarra, Spain), pine grove (*Pinus nigra nigra*), 610 m, Arbea & Moreno leg., 21.V.1986, holotype ♀; 3.XI.1986, paratype ♂ (coll. Zoology Museum, University of Navarra, Spain).

Other material examined. Urricelqui (Navarra, Spain), beech forest (*Fagus sylvatica*), 600 m, Moraza leg., 17.XI.1978, 1 subadult ♂ (coll. Zoology Museum, University of Navarra, Spain).

## Description

Length 0.82–1.06 mm. White. Antennal segments I, II, III with 7, 11, 19 setae. Antennal sense organ III complete (five dorsal solenidia and one ventral solenidion). Antennal segment IV with five thickened solenidia (*a-g*). The additional solenidion *e'* is not often thicker than the surrounding hairs (Fig. 6 B) (the solenidion *e'* is thickened in one male examined). Postantennal organ with 10–12 compound vesicles. Tibiotarsi with 11 setae, three of which are long, knobbed ventral setae. Claw without inner tooth. Unguiculus absent. Ventral tube with 4+4 setae. Formula of pseudocelli: 11/122/22221 (Fig. 6 C-D). Abdominal segment VI with nine anal spines in all, like *N. novemspina novemspina* (Fig. 7 E). Chaetotaxy of the body as in the nominated form (cf. Table V), except for the chaetotaxy of abdominal sternite IV: six anterior setae (*a2-a4*), six medial setae (*m2-m4*), and eight posterior setae (*p1-p4*) (Fig. 6 E). Length ratio *m2* : *m3* : *m4* : *m5* : *m6* : *p5* on the abdominal tergite IV as it follows, 10 : 7.5 : 50.5 : 19 : 31.5 : 46 (Fig. 6 A).

Chaetal variability. Symmetrical lack of setae *a3* on the abdominal tergite IV (1 subadult ♂); symmetrical presence of setae *a1* on the abdominal sternite IV (1 subadult ♂).

Affinities. The present new subspecies is closely related to the nominate form, *N. novemspina novemspina*, with the exception of the relative length of setae on the abdominal tergite IV, the chaetotaxy of the abdominal sternite IV, and the number of dorsal pseudocelli. Although the difference between the present and the nominate form is not so distinct, they are geographically separated from each other. Hence, I concluded that *N. novemspina navarrensis*, subsp. nov. should be regarded as a distinct subspecies within the species.

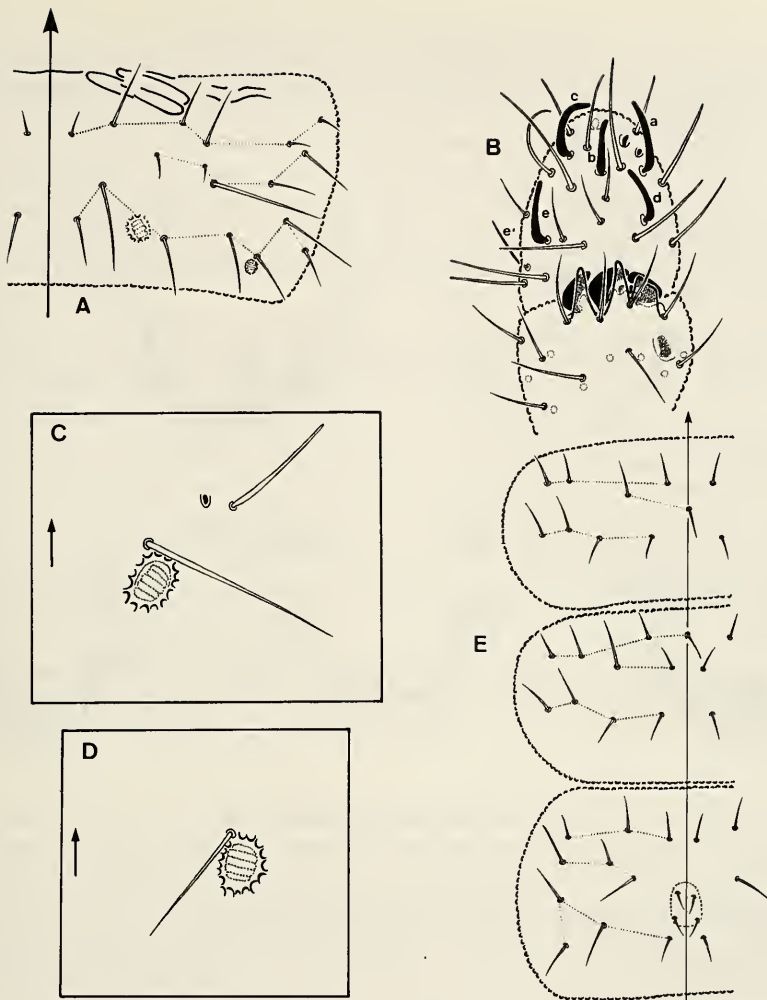


Fig. 6. *Neonaphorura novemspina navarrensis* subsp. nov. A. Chaetotaxy of the abdominal tergite IV. B. Antennal segments III–IV. C. Lateral pseudocellus on the thoracic tergite III. D. Lateral pseudocellus on the abdominal tergite III. E. Chaetotaxy of the abdominal sternites II–IV.

*Neonaphorura hexaspina* Arbea & Mateos, 1991

Fig. 7 A–B

Material examined. Serra de l'Obac, Terrassa, Barcelona (Spain), forest with holm oak (*Quercus ilex* L.) and Aleppo pine (*Pinus halepensis* Mill), 595 m, Mateos leg., 2. XII. 1987, holotype ♂ and 71 paratypes (23 ♂♂, 30 ♀♀, 18 juveniles) distributed in coll. E. Mateos, Barcelona, Spain, Zoological Museum, University of Navarra, Spain, National Museum of Natural Sciences, Madrid, Spain, and Zoologische Staatssammlung München.

Redescription

This species has been described in other paper (Arbea & Mateos, 1991). The characteristic features are the following: Antennal segment IV with five thickened solenidia (a–e). Postantennal organ with 10–15 compound vesicles. Formula of pseudocelli: 11/122/22221. Abdominal segment VI with six

anal spines in all; two true distal spines inserted on cuticular papillae, and four spine-like processes (1+1 lateral processes and two dorsomedial processes) (Fig. 7B). Chaetotaxy of the body is showed in Table VI. Length ratio of  $m2 : m3 : m4 : m5 : m6 : p5$  on the abdominal tergite IV as it follows, 10 : 7 : 29 : 14 : 21 : 22.5 (Fig. 7A).

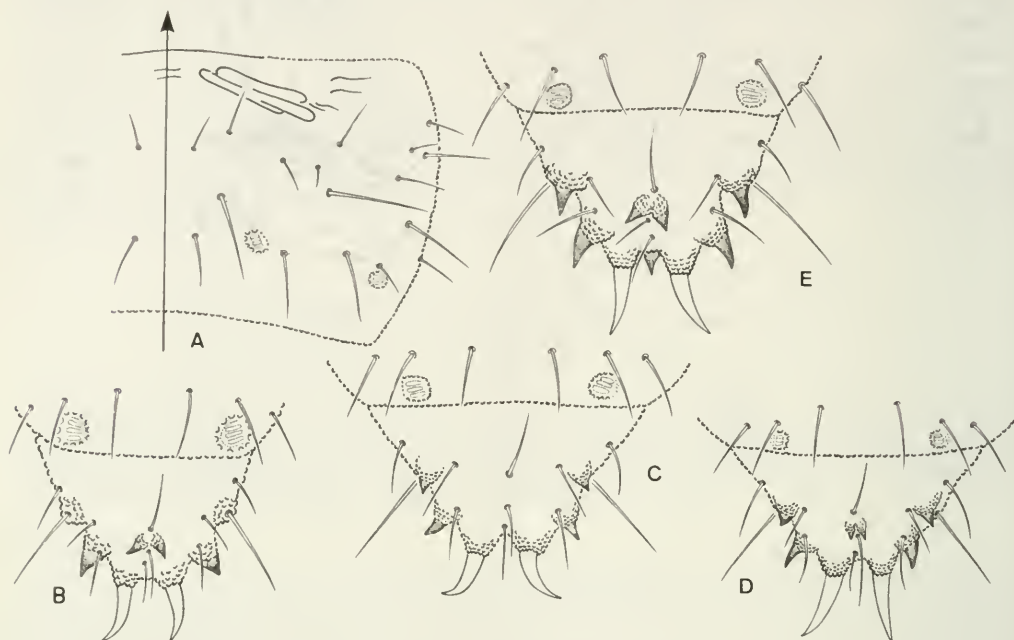


Fig. 7. A. *Neonaphorura hexaspina*. Chaetotaxy of the abdominal tergite IV. B-E. Abdominal segment VI. B. *Neonaphorura hexaspina*. C. *Neonaphorura duboscqi*. D. *Neonaphorura adulta*. E. *Neonaphorura novempina*.

Table VI. Chaetotaxy of *Neonaphorura hexaspina* Arbea & Mateos, 1991

DORSAL CHAETOTAXY							
Row	Th. I	Th. II-III	Abd. I	Abd. II	Abd. III	Abd. IV	Abd. V
a	—	10	10	12	12	10	10
m	8	8 (1)	4	8	8	10	6
p	—	8	12	12	12	14	8
Absent setae						a3	
VENTRAL CHAETOTAXY							
a	—	2	—	7	7	8-9	8
m	—	—	4	3	4	6	—
p	—	—	—	8	8	8	2
Absent setae				a2	a2	(a0) m1	

(1) + 2 lateral sensillae + 2 lateral microsensillae

Key to species of *Neonaphorura* Bagnall, 1935

1. Abdominal segment VI with six anal spines in all; two true distal spines inserted on cuticular papillae, and 2+2 lateral spine-like processes (Fig. 7C). Postantennal organ with 10–12 compound vesicles (Figs 3F+G) 2.
  - Abdominal segment VI with six, eight or nine spines in all, but always with two dorsomedial spine-like processes (Fig. 7B, D, E) . . . . . 3.
2. Setae *m3* on the abdominal tergite IV are present (Fig. 2A). Abdominal sternites II and IV without an unpaired anterior seta *a0* (Fig. 1) . . . . . *N. duboscqi duboscqi*
  - Setae *m3* on the abdominal tergite IV are absent (Fig. 3A). Abdominal sternites II and IV with an unpaired anterior seta *a0* (Fig. 3E) . . . . . *N. duboscqi ariegica*, subsp. nov.
3. Abdominal segment VI with nine anal spines in all; two true distal spines inserted on cuticular papillae, and seven spine-like processes: 2+2 lateral processes, two dorsomedial processes and one unpaired ventromedial process (Fig. 7E). Postantennal organ with 10–12 compound vesicles . . . . . 4.
  - Abdominal segment VI with six or eight anal spines . . . . . 5.
4. Abdominal segment IV without lateral pseudocellus. Setae *m6* on the abdominal tergite IV longer than *p5* (Fig. 5A) . . . . . *N. novemspina novemspina*
  - Abdominal segment IV with one lateral pseudocellus on each side, behind *p4a* setae. Setae *m6* on the abdominal tergite IV slightly shorter than *p5* (Fig. 6A) . . . . . *N. novemspina navarrensis*, subsp. nov.
5. Abdominal segment VI with six anal spines in all; two true distal spines inserted on cuticular papillae, and four spine-like processes: 1+1 lateral processes, and two dorsomedial processes (Fig. 7B). Postantennal organ with 10–15 compound vesicles . . . . . *N. hexaspina*
  - Abdominal segment VI with eight anal spines in all; two true distal spines inserted on cuticular papillae, and six spine-like processes: 2+2 lateral processes, and two dorsomedial processes (Fig. 7D). Postantennal organ with 19–23 compound vesicles (Fig. 4E–F) . . . . . *N. adulta*

Acknowledgements

I wish to express my deep gratitude to Dr. Rafael Jordana of Navarra University, for laboratory facilities and criticism. Dr. Henrik Enghoff (Zoological Museum, University of Copenhagen), Dr. José Carlos Simón (University of Madrid), Dr. Jelena Bogojević (University of Belgrade), Dr. Louis Deharveng (University Paul Sabatier, Toulouse) and Mr. Eduardo Mateos (University of Barcelona) have kindly lent me many interesting specimens from various places in Europe, for which I also express my gratitude.

Resumen

Se redefine el género *Neonaphorura* Bagnall, 1935, modificando su diagnosis con adición de nuevos caracteres. Se describen las especies europeas y se describen dos nuevas subespecies, *N. duboscqi ariegica* subsp. nov. y *N. novemspina navarrensis* subsp. nov. Se incluye una clave de todas las especies.

Résumé

Le genre *Neonaphorura* Bagnall, 1935 est redéfinie dans ce travail. On modifie la diagnose en ajoutant de nouveaux caractères. On redécrit les espèces européennes et on décrit deux nouvelles subespèces, *N. duboscqi ariegica* subsp. nov. et *N. novemspina navarrensis* subsp. nov. On présente une clé des espèces.

## References

- Arbea, J. I. & E. Mateos 1991. A new species of Collembola (Onychiuridae: Tullbergiinae) from Northern Spain. — *Spixiana*. **14/2**:
- Bagnall, R. S. 1935. On the classification of the Onychiuridae (Collembola), with particular reference to the genus *Tullbergia* Lubbock and its allies. — *Ann. Mag. Nat. Hist.* (10) **15**: 236–242
- Bogojević, J. 1980. Fauna of Collembola of the Djerdap Area II. Area Donji Milanovac-Kladovo. — *Proceedings on the Fauna of Serbia* **1**: 31–47
- Denis, J. R. 1932. Sur la faune française des Apterygotes XII. — *Arch. Zool. Exp. et Gén.* **74**: 357–383
- Gisin, H. 1944. Materialien zur Revision der Collembolen II. Weiteres Basler Material. — *Mitt. schw. ent. Ges.* **19**: 121–156
- — 1963. Sieben neue Arten von Collembolen aus Bosnien und Wiederbeschreibung von *Onychiurus serratotuberculatus* Stach. — *Godisnjak biol. Inst. Univ. Sarajevo* **14**: 1–13
- Haarlov, N. 1960. Microarthropods from Danish soils. Ecology, Phenology. — *Oikos Suppl.* **3**: 1–176
- Najt, J. & I. Rubio 1978. Tullbergiinae sud-américaines. I. Le genre *Dinaphorura* (Coll.). — *Nouv. Rev. Ent.* **8** (2): 95–112
- Salmon, J. T., 1964. An index to the Collembola. — *Bull. R. Soc. N. Z.* **7**: 1–651
- Wray, D. L. 1958. New forms of North American Collembola. — *Nature Notes afield. Raleigh. N. C.* **2**: 1–12